



DEPARTMENT OF COMMERCE

Bureau of Industry and Security

15 CFR Parts 772 and 774

[Docket No. 220802-0168]

RIN 0694-AH91

Implementation of Certain 2021 Wassenaar Arrangement Decisions on Four Section 1758 Technologies

AGENCY: Bureau of Industry and Security, Department of Commerce.

ACTION: Interim final rule, with request for comments.

SUMMARY: The Bureau of Industry and Security (BIS) maintains, as part of its Export Administration Regulations (EAR), the Commerce Control List (CCL), which identifies certain items subject to Department of Commerce (Commerce) jurisdiction. Commerce is revising the CCL, as well as corresponding parts of the EAR, to implement controls on four technologies. These changes reflect certain controls decided by governments participating in the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies (WA) at the December 2021 WA Plenary meeting. These four technologies meet the criteria of Section 1758 of the Export Control Reform Act (ECRA) pertaining to emerging and foundational technologies. Accordingly, BIS is accelerating their publication in this interim final rule and will publish the remaining WA-agreed controls in a later rule. These technologies are two substrates of ultra-wide bandgap semiconductors (Gallium Oxide (Ga₂O₃) and diamond), Electronic Computer Aided Design (ECAD) software specially designed for the development of integrated circuits with any Gate-All-Around Field-Effect Transistor (GAAFET) structure, and pressure gain combustion (PGC) technology for the production and development of gas turbine engine components or systems.

DATES: *Effective dates:* This rule is effective [INSERT DATE OF PUBLICATION IN THE

FEDERAL REGISTER], except for instruction 5, concerning the addition of Export Control Classification Number (ECCN) 3D006, which is effective **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

Comment due date: Comments regarding the implementation of ECCN 3D006 must be received by BIS no later than **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: Comments on this rule related to the implementation of ECCN 3D006 on the Commerce Control List may be submitted to the Federal rulemaking portal (www.regulations.gov). The regulations.gov ID for this rule is: BIS-2022-0006. Please refer to RIN 0694-AH91 in all comments.

All filers using the portal should use the name of the person or entity submitting the comments as the name of their files, in accordance with the instructions below. Anyone submitting business confidential information should clearly identify the business confidential portion at the time of submission, file a statement justifying nondisclosure and referring to the specific legal authority claimed, and also provide a non-confidential version of the submission.

For comments submitted electronically containing business confidential information, the file name of the business confidential version should begin with the characters “BC.” Any page containing business confidential information must be clearly marked “BUSINESS CONFIDENTIAL” on the top of that page. The corresponding non-confidential version of those comments must be clearly marked “PUBLIC.” The file name of the non-confidential version should begin with the character “P.” Any submissions with file names that do not begin with either a “BC” or a “P” will be assumed to be public and will be made publicly available through <https://www.regulations.gov>.

FOR FURTHER INFORMATION CONTACT: For general questions, contact Sharron Cook, Office of Exporter Services, Bureau of Industry and Security, U.S. Department of Commerce at 202-482-2440 or by e-mail: Sharron.Cook@bis.doc.gov.

For technical questions contact:

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SUPPLEMENTARY INFORMATION:**Background****Identification of Section 1758 Technologies**

As part of the National Defense Authorization Act (NDAA) for Fiscal Year 2019 (Public Law 115-232), Congress enacted the Export Control Reform Act of 2018 (ECRA) (50 U.S.C. 4801-4852). Section 1758 of ECRA (50 U.S.C. 4817) authorizes BIS to establish appropriate controls on the export, reexport, or transfer (in-country) of emerging and foundational technologies that are essential to the national security of the United States (Section 1758 technologies). See *Commerce Control List: Proposed Controls on Certain Marine Toxins; Request for Comments* (87 FR 31195, May 23, 2022) (stating that BIS will characterize all technologies identified pursuant to Section 1758 of ECRA as “Section 1758 technologies”).

This interim final rule adds four technologies to the CCL, supplement no. 1 to part 774, as Section 1758 technologies. These technologies were decided upon by governments participating in the WA for addition to the WA’s List of Dual-Use Goods and Technologies during the December 2021 WA Plenary meeting. The WA advocates implementation of effective export controls on strategic items with the objective of improving regional and international security and stability. Of the items regarding which decisions were reached in December 2021, four meet the requirements that apply to Section 1758 technologies. Namely, they were identified in a regular ongoing interagency process that is informed by multiple sources (*e.g.*, WA Participating States, industry, Federal technical advisory committees, and Federal Government agencies) and are essential to the national security of the United States. As such, early implementation in the EAR of the December 2021 WA Plenary meeting decisions

regarding these four “Section 1758 technologies” is warranted. BIS will amend the EAR to implement the remaining decisions reached at the December 2021 WA Plenary meeting in a separate rule.

BIS has determined that two substrates of ultra-wide bandgap semiconductors (Ga_2O_3 and diamond), ECAD software specially designed for the development of integrated circuits with any GAAFET structure, and pressure gain combustion technology for the production and development of gas turbine engine components or systems, are Section 1758 technologies. This interim final rule revises the CCL as well as corresponding parts of the EAR to implement controls on these four technologies by revising five ECCNs and adding one new ECCN, as follows:

- Revises ECCNs: 3C001.d -.f, 3C005.a and .b, 3C006, and 3E003 for two substrates (Ga_2O_3 and diamond) of ultra-wide bandgap semiconductors; and 9E003.a.2.e for PGC technology.
- New ECCN: 3D006 for Software for ECAD for the development of Integrated Circuits (ICs) with GAAFET.

Substrates of ultra-wide bandgap semiconductors

Gallium Nitride (GaN) and Silicon Carbide (SiC) are the leading materials for the production of sophisticated microwave or millimeter wave devices controlled under ECCN 3A001.b or high-power semiconductor devices controlled under ECCNs 3A001.g and 3A001.h on the CCL. In addition to GaN and SiC, materials such as Ga_2O_3 and diamond have a strong potential for use in military applications and are being developed to be used to fabricate more sophisticated devices than those produced using GaN or SiC. The devices made from Ga_2O_3 or diamond are expected to work under more severe conditions, such as higher voltage or higher temperature, than the devices made from GaN or SiC. Substrates made from GaN or SiC are controlled under ECCNs 3C001, 3C005, and 3C006, and related technologies other than those

controlled under ECCN 3E001 are covered by ECCN 3E003. Because of their significant military potential, with this rule, BIS adds these technologies - Ga₂O₃ and diamond – as Section 1758 technologies to the CCL in the ECCNs 3C001.d -.f, 3C005.a and .b, and 3C006.

Specifically, this rule adds to ECCN 3C001 new paragraphs .e for Ga₂O₃ and .f for diamond, and amends ECCN 3C005 by adding Ga₂O₃ and diamond to ECCN 3C005 paragraphs .a and .b, respectively. In conforming changes, it also amends ECCN 3C001.c by removing the word “or”, amends the Note to 3C001.d by adding the chemical names for all of the relevant chemical formulas, and amends the heading of ECCN 3C006 by adding Ga₂O₃ and diamond and the chemical formulas for the existing listed chemicals. ECCN 3E003 is amended by removing the phrase “films of” from 3E003.d, by adding the chemical formulas for the existing listed chemicals in 3E003.d - .f, and by adding paragraph 3E003.h to control “technology” for the “development” or “production” of substrates of Ga₂O₃ for electronic components. “Technology” for the “development” or “production” of substrates of diamond is already listed in 3E003.d.

Commodities specified in ECCN 3C001 paragraphs .c and .f, ECCN 3C005 paragraphs .a and .b, and ECCN 3C006 require a license for national security (NS) and antiterrorism (AT) reasons, respectively, for countries with an “X” listed in columns NS:2 or AT:1 on the Commerce Country Chart in supplement no. 1 to part 738 of the EAR. The development and production technology for these commodities is classified under ECCN 3E003 and requires a license for NS and AT reasons, respectively, to countries with an “X” listed in columns NS:1 or AT:1 on the Commerce Country Chart. A license exception (see part 740 of the EAR) may authorize a transaction that otherwise would require a license.

Software for ECAD for the development of ICs with GAAFET

Electronic Computer-Aided Design (ECAD) is a category of software tools used for designing, analyzing, optimizing, and validating the performance of integrated circuits or printed circuit boards. ECAD software is used by the military and aerospace defense industries for

designing complex integrated circuits, Field-Programmable Gate Arrays (FPGAs), Application Specific Integrated Circuits (ASICs), and electronic systems. ECAD software solutions enabled a successful design phase of the first Gate-All-Around transistor System-on-Chip test chip.

A common use of ECAD software is to link the various stages involved in progressing smoothly from the Register Transfer Level (RTL) design stage to the logic design stage, then finally to the physical design stage, which results in Geometrical Database Standard II (GDSII). RTL is a model of a digital circuit defined in terms of the flow of digital signals and logical operations down to the level of individual flip-flops, *i.e.*, a device that stores a single bit (binary digit) of data. GDSII is the database standard format for describing integrated circuit layout artwork. It is used to contain all information describing the integrated circuit's layout artwork in a standardized database format that may be shared with foundries for transferring artwork between different tools or for building photomasks. ECAD software with a complete RTL-to-GDSII design solution includes proprietary design planning, power optimization, physical synthesis, clock tree synthesis, and routing for logical and physical design implementations throughout the design flow.

Gate-All-Around transistor technology approaches are key to scaling to 3 nanometer and below technology nodes. The gate completely encircles the semiconductor electronic conduction channel and thus provides good gate control and scalability of the electrostatics to allow high ratios of on and off leakage currents and minimization of random dopant fluctuations. A thin electronic conducting channel is used to enable gate control of the electric field in the transistor channel preventing short-channel punch through. The backside gate combined with minimization of random doping effect enable scalability to smaller technology nodes. The multiple channels provide higher current capability. The lower parasitic capacitances enable 50 percent faster chip operation compared to bulk technologies. Faster, less bulky, energy efficient, and radiation-hardened integrated circuits would advance many commercial as well as military applications, including defense and communication satellites.

ECAD software is often offered in modules that support the requirements of circuit designers as well as the production prerequisites supplied by foundries. ECAD software is not distinguished by the type or architecture of integrated circuit, but by the capabilities that enable design, analysis, optimization, validation, and verification of the advanced circuitry of specific transistor types. Thus, some ECAD software may be particularly suited to efficiently design complex GAAFET circuits. As proprietary information could be involved, the “specially designed” requirements of the control can be difficult to ascertain in specific ECAD software.

Consequently, with this rule, BIS is controlling this technology as Section 1758 technology by adding new ECCN 3D006 to the CCL to control ECAD “software” “specially designed” for the “development” of integrated circuits having any GAAFET structure and meeting the parameters set forth in ECCN 3D006. Such software must be either “specially designed” for implementing RTL to GDSII or an equivalent standard or “specially designed” for optimization of power or timing rules.

ECCN 3D006 will also include a new technical note that defines ECAD, RTL, and GDSII. ECAD software tools are designed to incorporate and work with the different process design kits (PDKs) from each foundry, which include specifications for that foundry’s transistor architecture. The new control applies to an ECAD software tool when it is specially designed as described in 3D006, whether it is exported with a PDK or separately.

ECAD software controlled under new ECCN 3D006 requires a license for NS and AT reasons, respectively, for countries with an “X” listed in columns NS:2 or AT:1 on the Commerce Country Chart. A license exception (see part 740 of the EAR), such as License Exception Strategic Trade Authorization (STA) may authorize a transaction that otherwise would require a license.

BIS seeks public comment and input to determine what specific ECAD features are particularly suited to design GAAFET circuits to ensure that the U.S. Government effectively implements this new control. In particular, the U.S. Government is seeking public comment and

input from industry regarding the scope of the license requirement as well as input to assist in the interagency review of license applications to export such software. BIS is particularly interested in description of software features or functions that assists the designer to optimize interconnects, synthesis, placements & routes, multi-corner multi-mode, timing/clock-tree, power and thermal, or signal integrity necessary for GAAFET circuits. For example, there may be a highly efficient auto-routing program or type of simulator or schematic editor/engine or waveform display that allows designers to rapidly modify a simulated circuit and assess what effect the change has on the output. Additionally, public comment may inform the U.S. Government in the development of future WA proposals that could revise the control text of 3D006.

In addition, BIS's Technical Advisory Committees recommended that industry has the opportunity to submit public comments regarding the implementation of ECCN 3D006 control, *i.e.*, license requirements applied, license exception eligibility, notes that may clarify the scope of the control, as well as recommendations to overcome compliance difficulties and recommendations for future revisions of the control text as the software undergoes technological advancements. Therefore, there is a 60-day delayed effective date for the addition of 3D006 to the CCL and a 30-day comment period with respect to the implementation of this control.

Pressure Gain Combustion (PGC)

PGC technology is a technology with the potential to increase gas turbine engine efficiency by more than 10%. PGC technology has extensive potential to impact terrestrial systems, as well as aerospace applications such as rockets and hypersonic systems.

While conventional gas turbine engines undergo steady, subsonic combustion, resulting in a total pressure loss, PGC utilizes multiple physical phenomena, including resonant pulsed combustion, constant volume combustion, and detonation, to cause a rise in effective pressure across the combustor, while consuming the same amount of fuel as the constant pressure combustor. This PGC technology, which results in a pressure gain across the combustor, relies

on the Humphrey (or Atkinson) cycles and has great potential as a means of achieving higher efficiency in gas turbine power systems. The two main advantages of utilizing PGC in a gas turbine engine are: (1) it reduces the essentially unsteady nature of the combustion cycle, resulting in an increase in thermodynamic efficiency, and (2) due to the pressure increase in the combustor, it allows fewer stages in the compressor, resulting in a more compact engine.

While BIS has not identified any engines currently in production using PGC, there is substantial ongoing research regarding potential production. In part because increased fuel efficiency and the potential for a more compact engine provide military advantages such as a longer loiter time and easier packaging. PGC-based propulsion systems for rockets, space launch vehicles, missiles, and military gas turbine engines, and technology directly related thereto, are already defense articles described on the U.S. Munitions List (USML). However, it is increasingly likely that commercial industrial gas turbine engines will be produced with PGC technology, which will likely be controlled on the CCL as Section 1758 technology.

This rule adds paragraph 9E003.a.2.e to control development and production technology for combustors utilizing ‘pressure gain combustion’ that are not described on the USML and adds a technical note to define ‘pressure gain combustion.’ Technology controlled under ECCN 9E003.a.2.e requires a license for NS and AT reasons, respectively, for countries with an “X” listed in columns NS:1 or AT:1 on the Commerce Country Chart. A license exception (see part 740 of the EAR) may authorize a transaction that otherwise would require a license.

Saving Clause (applicable to the items apart from 3D006 software)

Shipments of items removed from license exception eligibility or eligibility for export, reexport, or transfer (in-country) without a license as a result of this regulatory action that were on dock for loading, on lighter, laden aboard an exporting carrier, or en route aboard a carrier to a port of export, on **[INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, pursuant to actual orders for exports, reexports, and transfers (in-country) to a foreign

destination, may proceed to that destination under the previous license exception eligibility or without a license so long as they have been exported, reexported, or transferred (in-country) before **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Any such items not actually exported, reexported, or transferred (in-country) before midnight, on **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, require a license in accordance with this interim final rule.

Saving Clause for 3D006 software

Shipments of items removed from license exception eligibility or eligibility for export, reexport or transfer (in-country) without a license as a result of this regulatory action that were on dock for loading, on lighter, laden aboard an exporting carrier, or en route aboard a carrier to a port of export, on **[INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, pursuant to actual orders for exports, reexports, and transfers (in-country) to a foreign destination, may proceed to that destination under the previous license exception eligibility or without a license so long as they have been exported, reexported, or transferred (in-country) before **[INSERT DATE 90 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**. Any such items not actually exported, reexported, or transferred (in-country) before midnight, on **[INSERT DATE 90 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, require a license in accordance with this interim final rule.

Export Control Reform Act of 2018

On August 13, 2018, the President signed into law the John S. McCain National Defense Authorization Act for Fiscal Year 2019, which included the ECRA, 50 U.S.C. Sections 4801–4852. ECRA provides the legal basis for BIS’s principal authorities and serves as the authority under which BIS issues this rule.

Rulemaking Requirements

1. Executive Orders 13563 and 12866 direct agencies to assess all costs and benefits of available regulatory alternatives and, if regulation is necessary, to select regulatory approaches that maximize net benefits (including potential economic, environmental, public health and safety effects and distributive impacts and equity). Executive Order 13563 emphasizes the importance of quantifying both costs and benefits and of reducing costs, harmonizing rules, and promoting flexibility. This interim final rule has been designated a “significant regulatory action” under section 3(f) of Executive Order 12866. This rule does not contain policies with federalism implications as that term is defined under Executive Order 13132.

2. Notwithstanding any other provision of law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.) (PRA), unless that collection of information displays a currently valid Office of Management and Budget (OMB) Control Number. Although this rule makes important changes to the EAR for items controlled for national security reasons, BIS believes that the overall increases in burdens and costs for the following collections fall will be minimal and fall within the already approved amounts for the following collections.

0694-0137 “License Exceptions and Exclusions,” which carries a burden-hour estimate average of 1.5 hours per submission (Note: submissions for License Exceptions are rarely required);

0694-0096 “Five Year Records Retention Period,” which carries a burden-hour estimate of less than 1 minute; and

0607-0152 “Automated Export System (AES) Program,” which carries a burden-hour estimate of 3 minutes per electronic submission.

0694-0088, “Simplified Network Application Processing System,” which carries a burden- hour estimate of 29.4 minutes for a manual or electronic submission.

3. Pursuant to Section 1762 of the ECRA (50 U.S.C. 4821), this action is exempt from the Administrative Procedure Act (APA) (5 U.S.C. 553) requirements for notice of proposed rulemaking, opportunity for public participation and delay in effective date. However, on the recommendation of BIS’s Technical Advisory Committees, there is a 30-day comment period on the implementation of the control on ECCN 3D006 and a 60-day delayed effective date with respect to the addition of ECCN 3D006 to the Commerce Control List.

List of Subjects

15 CFR Part 772

Exports.

15 CFR Part 774

Exports, Reporting and recordkeeping requirements, Terrorism.

Accordingly, parts 772 and 774 of the Export Administration Regulations (15 CFR parts 730-774) are amended as follows:

PART 772 – DEFINITIONS OF TERMS

1. The authority citation for part 772 continues to read as follows:

Authority: 50 U.S.C. 4801-4852; 50 U.S.C. 4601 *et seq.*; 50 U.S.C. 1701 *et seq.*; E.O. 13222, 66 FR 44025, 3 CFR, 2001 Comp., p. 783.

2. Section 772.1 is amended by adding *Gate-All-Around Field-Effect Transistor* (“*GAAFET*”) in alphabetical order to read as follows:

§ 772.1 Definitions of terms as used in the Export Administration Regulations (EAR).

Gate-All-Around Field-Effect Transistor (“*GAAFET*”). (Cat 3) -- A device having a single or multiple semiconductor conduction channel element(s) with a common gate structure that surrounds and controls current in all of the semiconductor conduction channel elements. (*Note:* This definition includes nanosheet or nanowire field-effect and surrounding gate transistors and other “*GAAFET*” semiconductor channel element structures.)

PART 774 – THE COMMERCE CONTROL LIST

3. The authority citation for part 774 continues to read as follows:

Authority: 50 U.S.C. 4801-4852; 50 U.S.C. 4601 *et seq.*; 50 U.S.C. 1701 *et seq.*; 10 U.S.C. 8720; 10 U.S.C. 8730(e); 22 U.S.C. 287c, 22 U.S.C. 3201 *et seq.*; 22 U.S.C. 6004; 42 U.S.C. 2139a; 15 U.S.C. 1824; 50 U.S.C. 4305; 22 U.S.C. 7201 *et seq.*; 22 U.S.C. 7210; E.O. 13026, 61 FR 58767, 3 CFR, 1996 Comp., p. 228; E.O. 13222, 66 FR 44025, 3 CFR, 2001 Comp., p. 783.

4. In supplement no. 1 to part 774, Category 3, ECCN 3C001, 3C005, and 3C006 are revised to read as follows:

Supplement No. 1 to Part 774—The Commerce Control List

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3C001 Hetero-epitaxial materials consisting of a “substrate” having stacked epitaxially grown multiple layers of any of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

<i>Control(s)</i>	<i>Country Chart (See Supp. No. 1 to part 738)</i>
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

AT applies to entire entry AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: \$3000

GBS: N/A

List of Items Controlled

Related Controls: This entry does not control equipment or material whose functionality has been unalterably disabled.

Related Definitions: N/A

Items:

- a. Silicon (Si);
- b. Germanium (Ge);
- c. Silicon Carbide (SiC);
- d. “III/V compounds” of gallium or indium;

***Note:** 3C001.d does not apply to a “substrate” having one or more P-type epitaxial layers of Gallium Nitride (GaN), Indium Gallium Nitride (InGaN), Aluminum Gallium Nitride (AlGaN), Indium Aluminum Nitride (InAlN), Indium Aluminum Gallium Nitride (InAlGaN), Gallium Phosphide (GaP), Gallium Arsenide (GaAs), Aluminum Gallium Arsenide (AlGaAs), Indium Phosphide (InP), Indium Gallium Phosphide (InGaP), Aluminum Indium Phosphide (AlInP), or Indium Gallium Phosphide (InGaAlP), independent of the sequence of the elements, except if the P-type epitaxial layer is between N-type layers.*

e. Gallium Oxide (Ga₂O₃); or

f. Diamond.

3C005 High resistivity materials as follows (See List of Items Controlled).

License Requirements

Reason for Control: NS, AT

<i>Control(s)</i>	<i>Country Chart (See Supp. No. 1 to part 738)</i>
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: \$3000

GBS: Yes

List of Items Controlled

Related Controls: See ECCN 3E001 for related development and production technology, and ECCN 3B991.b.1.b for related production equipment.

Related Definition: N/A

Items:

a. Silicon Carbide (SiC), Gallium Nitride (GaN), Aluminum Nitride (AlN), Aluminum Gallium Nitride (AlGaN), Gallium Oxide (Ga₂O₃), or diamond semiconductor “substrates”, or ingots, boules, or other preforms of those materials, having resistivities greater than 10,000 ohm-cm at 20°C;

b. Polycrystalline “substrates” or polycrystalline ceramic “substrates”, having resistivities greater than 10,000 ohm-cm at 20°C and having at least one non-epitaxial single-crystal layer of Silicon (Si), Silicon Carbide (SiC), Gallium Nitride (GaN), Aluminum Nitride (AlN), Aluminum Gallium Nitride (AlGaN), Gallium Oxide (Ga₂O₃), or diamond on the surface of the “substrate”.

3C006 Materials, not specified by 3C001, consisting of a “substrate” specified by 3C005 with at least one epitaxial layer of Silicon Carbide (SiC), Gallium Nitride (GaN), Aluminum Nitride (AlN), Aluminum Gallium Nitride (AlGaN), Gallium Oxide (Ga₂O₃) or diamond.

License Requirements

Reason for Control: NS, AT

<i>Control(s)</i>	<i>Country Chart (See Supp. No. 1 to part 738)</i>
NS applies to entire entry	NS Column 2

AT applies to entire entry	AT Column 1
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List Based License Exceptions (See Part 740 for a description of all license exceptions)

LVS: \$3000

GBS: Yes

List of Items Controlled

Related Controls: See ECCN 3D001 for related “development” or “production” “software”, ECCN 3E001 for related “development” and “production” “technology”, and ECCN 3B991.b.1.b for related “production” equipment.

Related Definition: N/A

Items:

The list of items controlled is contained in the ECCN heading.

5. Effective [INSERT DATE 60 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER], in supplement no. 1 to part 774, Category 3, ECCN 3D006 is added after 3D005 to read as follows:

3D006 ‘Electronic Computer-Aided Design’ (‘ECAD’) “software” “specially designed” for the “development” of integrated circuits having any “Gate-All-Around Field-Effect

Transistor” (“GAAFET”) structure, and having any of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

<i>Control(s)</i>	<i>Country Chart (See Supp. No. 1 to part 738)</i>
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

TSR: N/A

List of Items Controlled

Related Controls: N/A

Related Definitions: N/A

Items:

- a. “Specially designed” for implementing ‘Register Transfer Level’ (‘RTL’) to ‘Geometrical Database Standard II’ (‘GDSII’) or equivalent standard; or
- b. “Specially designed” for optimization of power or timing rules.

Technical Notes:

1. *‘Electronic Computer-Aided Design’ (‘ECAD’) is a category of “software” tools used for designing, analyzing, optimizing, and validating the performance of an integrated circuit or printed circuit board.*
 2. *‘Register Transfer Level’ (‘RTL’) is a design abstraction which models a synchronous digital circuit in terms of the flow of digital signals between hardware registers and the logical operations performed on those signals.*
 3. *‘Geometrical Database Standard II’ (‘GDSII’) is a database file format for data exchange of integrated circuit or integrated circuit layout artwork.*
6. In supplement no. 1 to part 774, Category 3, ECCN 3E003 is revised to read as follows:

3E003 Other “technology” for the “development” or “production” of the following (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

<i>Control(s)</i>	<i>Country Chart (See Supp. No. 1 to part 738)</i>
NS applies to entire entry	NS Column 1
AT applies to entire entry	AT Column 1

List Based License Exceptions (See Part 740 for a description of all license exceptions)

TSR: Yes, except .f and .g

List of Items Controlled

Related Controls: See 3E001 for Silicon-On-Insulation (SOI) technology for the “development” or “production” related to radiation hardening of integrated circuits.

Related Definitions: N/A

Items:

- a. Vacuum microelectronic devices;

b. Hetero-structure semiconductor electronic devices such as high electron mobility transistors (HEMT), hetero-bipolar transistors (HBT), quantum well and super lattice devices;

***Note:** 3E003.b does not control “technology” for high electron mobility transistors (HEMT) operating at frequencies lower than 31.8 GHz and hetero-junction bipolar transistors (HBT) operating at frequencies lower than 31.8 GHz.*

c. “Superconductive” electronic devices;

d. Substrates of diamond for electronic components;

e. Substrates of Silicon-On-Insulator (SOI) for integrated circuits in which the insulator is Silicon Dioxide (SiO₂);

f. Substrates of Silicon Carbide (SiC) for electronic components;

g. “Vacuum electronic devices” operating at frequencies of 31.8 GHz or higher;

h. Substrates of Gallium Oxide (Ga₂O₃) for electronic components.

7. In supplement no. 1 to part 774, Category 9, ECCN 9E003 is revised to read as follows:

9E003 Other “technology” as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, SI, AT

<i>Control(s)</i>	<i>Country Chart (See Supp. No. 1 to part 738)</i>
NS applies to entire entry	NS Column 1
SI applies to 9E003.a.1 through a.8, .h, .i, and .k.	See §742.14 of the EAR for additional information.
AT applies to entire entry	AT Column 1

Reporting Requirements

See § 743.1 of the EAR for reporting requirements for exports under License Exceptions and Validated End-User authorizations.

List Based License Exceptions (See Part 740 for a description of all license exceptions)

TSR: N/A

Special Conditions for STA

STA: License Exception STA may not be used to ship or transmit any technology in 9E003.a.1, 9E003.a.2 to a.5, 9E003.a.8, or 9E003.h to any of the destinations listed in Country Group A:6 (See supplement No.1 to part 740 of the EAR).

List of Items Controlled

Related Controls: (1) Hot section “technology” “specifically designed,” modified, or equipped for military uses or purposes, or developed principally with U.S. Department of Defense funding, is “subject to the ITAR” (see 22 CFR parts 120 through 130). (2) “Technology” is subject to the EAR when actually applied to a commercial “aircraft” engine program. Exporters may seek to establish commercial application either on a case-by-case basis through submission of documentation demonstrating application to a commercial program in requesting an export license from the Department Commerce in respect to a specific export, or in the case of use for broad categories of “aircraft,” engines, “parts” or “components,” a commodity jurisdiction determination from the Department of State.

Related Definitions: N/A

Items:

a. “Technology” “required” for the “development” or “production” of any of the following gas turbine engine “parts,” “components” or systems:

a.1. Gas turbine blades, vanes or “tip shrouds”, made from Directionally Solidified (DS) or Single Crystal (SC) alloys and having (in the 001 Miller Index Direction) a stress-rupture life exceeding 400 hours at 1,273 K (1,000°C) at a stress of 200 MPa, based on the average property values;

Technical Note: For the purposes of 9E003.a.1, stress-rupture life testing is typically conducted on a test specimen.

a.2. Combustors having any of the following:

a.2.a. ‘Thermally decoupled liners’ designed to operate at ‘combustor exit temperature’ exceeding 1,883 K (1,610°C);

a.2.b. Non-metallic liners;

a.2.c. Non-metallic shells;

a.2.d. Liners designed to operate at ‘combustor exit temperature’ exceeding 1,883 K (1,610°C) and having holes that meet the parameters specified by 9E003.c; or

a.2.e. Utilizing ‘pressure gain combustion’;

Technical Note: In ‘pressure gain combustion’ the bulk average stagnation pressure at the combustor outlet is greater than the bulk average stagnation pressure at the combustor inlet due primarily to the combustion process, when the engine is running in a “steady state mode” of operation.

Note: The “required” “technology” for holes in 9E003.a.2 is limited to the derivation of the geometry and location of the holes.

Technical Notes:

1. *‘Thermally decoupled liners’ are liners that feature at least a support structure designed to carry mechanical loads and a combustion facing structure designed to protect the support structure from the heat of combustion. The combustion facing structure and support structure have independent thermal displacement (mechanical displacement due to thermal load) with respect to one another, i.e., they are thermally decoupled.*

2. *‘Combustor exit temperature’ is the bulk average gas path total (stagnation) temperature between the combustor exit plane and the leading edge of the turbine inlet guide vane (i.e., measured at engine station T40 as defined in SAE ARP 755A) when the engine is running in a “steady state mode” of operation at the certificated maximum continuous operating temperature.*

N.B.: See 9E003.c for “technology” “required” for manufacturing cooling holes.

a.3. “Parts” or “components,” that are any of the following:

a.3.a. Manufactured from organic “composite” materials designed to operate above 588 K (315°C);

a.3.b. Manufactured from any of the following:

a.3.b.1. Metal “matrix” “composites” reinforced by any of the following:

a.3.b.1.a. Materials controlled by 1C007;

a.3.b.1.b. “Fibrous or filamentary materials” specified by 1C010; *or*

a.3.b.1.c. Aluminides specified by 1C002.a; *or*

a.3.b.2. Ceramic “matrix” “composites” specified by 1C007; *or*

a.3.c. Stators, vanes, blades, tip seals (shrouds), rotating blings, rotating blisks or ‘splitter ducts’, that are all of the following:

a.3.c.1. Not specified in 9E003.a.3.a;

a.3.c.2. Designed for compressors or fans; *and*

a.3.c.3. Manufactured from material controlled by 1C010.e with resins controlled by 1C008;

Technical Note: A ‘splitter duct’ performs the initial separation of the air-mass flow between the bypass and core sections of the engine.

a.4. Uncooled turbine blades, vanes or “tip shrouds” designed to operate at a ‘gas path temperature’ of 1,373 K (1,100°C) or more;

a.5. Cooled turbine blades, vanes or “tip-shrouds”, other than those described in 9E003.a.1, designed to operate at a ‘gas path temperature’ of 1,693 K (1,420°C) or more;

Technical Note: ‘Gas path temperature’ is the bulk average gas path total (stagnation) temperature at the leading-edge plane of the turbine component when the engine is running in a “steady state mode” of operation at the certificated or specified maximum continuous operating temperature.

a.6. Airfoil-to-disk blade combinations using solid state joining;

a.7. [Reserved]

a.8. ‘Damage tolerant’ gas turbine engine rotor “parts” or “components” using powder metallurgy materials controlled by 1C002.b; *or*

***Technical Note:** ‘Damage tolerant’ “parts” and “components” are designed using methodology and substantiation to predict and limit crack growth.*

a.9. [Reserved]

***N.B.:** For “FADEC systems”, see 9E003.h.*

a.10. [Reserved]

***N.B.:** For adjustable flow path geometry, see 9E003.i.*

a.11. ‘Fan blades’ having all of the following:

a.11.a. 20% or more of the total volume being one or more closed cavities containing vacuum or gas only; *and*

a.11.b. One or more closed cavities having a volume of 5 cm³ or larger;

Technical Note: For the purposes of 9E003.a.11, a 'fan blade' is the airfoil portion of the rotating stage or stages, which provide both compressor and bypass flow in a gas turbine engine.

b. "Technology" "required" for the "development" or "production" of any of the following:

b.1. Wind tunnel aero-models equipped with non-intrusive sensors capable of transmitting data from the sensors to the data acquisition system; *or*

b.2. "Composite" propeller blades or prop-fans, capable of absorbing more than 2,000 kW at flight speeds exceeding Mach 0.55;

c. "Technology" "required" for manufacturing cooling holes, in gas turbine engine "parts" or "components" incorporating any of the "technologies" specified by 9E003.a.1, 9E003.a.2 or 9E003.a.5, and having any of the following:

c.1. Having all of the following:

c.1.a. Minimum 'cross-sectional area' less than 0.45 mm²;

c.1.b. 'Hole shape ratio' greater than 4.52; *and*

c.1.c. 'Incidence angle' equal to or less than 25°; *or*

c.2. Having all of the following:

c.2.a. Minimum 'cross-sectional area' less than 0.12 mm²;

c.2.b. 'Hole shape ratio' greater than 5.65; *and*

c.2.c. 'Incidence angle' more than 25°;

Note: 9E003.c does not apply to “technology” for manufacturing constant radius cylindrical holes that are straight through and enter and exit on the external surfaces of the component.

Technical Notes:

1. For the purposes of 9E003.c, the 'cross-sectional area' is the area of the hole in the plane perpendicular to the hole axis.

2. For the purposes of 9E003.c, 'hole shape ratio' is the nominal length of the axis of the hole divided by the square root of its minimum 'cross-sectional area'.

3. For the purposes of 9E003.c, 'incidence angle' is the acute angle measured between the plane tangential to the airfoil surface and the hole axis at the point where the hole axis enters the airfoil surface.

4. Methods for manufacturing holes in 9E003.c include “laser” beam machining, water jet machining, Electro-Chemical Machining (ECM) or Electrical Discharge Machining (EDM).

d. “Technology” “required” for the “development” or “production” of helicopter power transfer systems or tilt rotor or tilt wing “aircraft” power transfer systems;

e. “Technology” for the “development” or “production” of reciprocating diesel engine ground vehicle propulsion systems having all of the following:

e.1. ‘Box volume’ of 1.2 m³ or less;

e.2. An overall power output of more than 750 kW based on 80/1269/EEC, ISO 2534 or national equivalents; *and*

e.3. Power density of more than 700 kW/m³ of ‘box volume’;

Technical Note: ‘Box volume’ is the product of three perpendicular dimensions measured in the following way:

Length: The length of the crankshaft from front flange to flywheel face;

Width: The widest of any of the following:

a. The outside dimension from valve cover to valve cover;

b. The dimensions of the outside edges of the cylinder heads; or

c. The diameter of the flywheel housing;

Height: The largest of any of the following:

a. The dimension of the crankshaft center-line to the top plane of the valve cover (or cylinder head) plus twice the stroke; or

b. The diameter of the flywheel housing.

f. “Technology” “required” for the “production” of “specially designed” “parts” or “components” for high output diesel engines, as follows:

f.1. “Technology” “required” for the “production” of engine systems having all of the following “parts” and “components” employing ceramics materials controlled by 1C007:

f.1.a Cylinder liners;

f.1.b. Pistons;

f.1.c. Cylinder heads; *and*

f.1.d. One or more other “part” or “component” (including exhaust ports, turbochargers, valve guides, valve assemblies or insulated fuel injectors);

f.2. “Technology” “required” for the “production” of turbocharger systems with single-stage compressors and having all of the following:

f.2.a. Operating at pressure ratios of 4:1 or higher;

f.2.b. Mass flow in the range from 30 to 130 kg per minute; *and*

f.2.c. Variable flow area capability within the compressor or turbine sections;

f.3. “Technology” “required” for the “production” of fuel injection systems with a “specially designed” multifuel (*e.g.*, diesel or jet fuel) capability covering a viscosity range from diesel fuel (2.5 cSt at 310.8 K (37.8°C)) down to gasoline fuel (0.5 cSt at 310.8 K (37.8°C)) and having all of the following:

f.3.a. Injection amount in excess of 230 mm³ per injection per cylinder; *and*

f.3.b. Electronic control features “specially designed” for switching governor characteristics automatically depending on fuel property to provide the same torque characteristics by using the appropriate sensors;

g. “Technology” “required” for the “development” or “production” of ‘high output diesel engines’ for solid, gas phase or liquid film (or combinations thereof) cylinder wall lubrication and permitting operation to temperatures exceeding 723 K (450°C), measured on the cylinder wall at the top limit of travel of the top ring of the piston;

Technical Note: ‘High output diesel engines’ are diesel engines with a specified brake mean effective pressure of 1.8 MPa or more at a speed of 2,300 r.p.m., provided the rated speed is 2,300 r.p.m. or more.

h. “Technology” for gas turbine engine “FADEC systems” as follows:

h.1. “Development” “technology” for deriving the functional requirements for the “parts” or “components” necessary for the “FADEC system” to regulate engine thrust or shaft power (e.g., feedback sensor time constants and accuracies, fuel valve slew rate);

h.2. “Development” or “production” “technology” for control and diagnostic “parts” or “components” unique to the “FADEC system” and used to regulate engine thrust or shaft power;

h.3. “Development” “technology” for the control law algorithms, including “source code”, unique to the “FADEC system” and used to regulate engine thrust or shaft power;

***Note:** 9E003.h does not apply to technical data related to engine-“aircraft” integration required by civil aviation authorities of one or more Wassenaar Arrangement Participating States (See supplement No. 1 to part 743 of the EAR) to be published for general airline use (e.g., installation manuals, operating instructions, instructions for continued airworthiness) or interface functions (e.g., input/output processing, airframe thrust or shaft power demand).*

i. “Technology” for adjustable flow path systems designed to maintain engine stability for gas generator turbines, fan or power turbines, or propelling nozzles, as follows:

i.1. “Development” “technology” for deriving the functional requirements for the “parts” or “components” that maintain engine stability;

i.2. “Development” or “production” “technology” for “parts” or “components” unique to the adjustable flow path system and that maintain engine stability;

i.3. “Development” “technology” for the control law algorithms, including “source code”, unique to the adjustable flow path system and that maintain engine stability;

***Note:** 9E003.i does not apply to “technology” for any of the following:*

a. Inlet guide vanes;

b. Variable pitch fans or prop-fans;

c. Variable compressor vanes;

d. Compressor bleed valves; or

e. Adjustable flow path geometry for reverse thrust.

j. “Technology” “required” for the “development” of wing-folding systems designed for fixed-wing “aircraft” powered by gas turbine engines.

***N.B.:** For “technology” “required” for the “development” of wing-folding systems designed for fixed-wing “aircraft” specified in USML Category VIII (a), see USML Category VIII (i).*

k. “Technology” not otherwise controlled in 9E003.a.1 through a.8, a.10, and .h and used in the “development”, “production”, or overhaul of hot section “parts” or “components” of civil derivatives of military engines controlled on the U.S. Munitions List.

Thea D. Rozman Kendler

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